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(54) **Blended look-up table for printing images with both pictorial and graphical elements**

Vermengte Nachschlagetabelle zum Drucken von Bildern, die Bild- und Graphikelemente enthalten

Table de consultation mélangée pour imprimer des images avec à la fois des éléments d'image et d'inscription

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Description

[0001] The present invention relates to the art of document reproduction It finds particular application in conjunction with printer reproduction of color image signals having both pictorial and graphical elements.

[0002] The generation of color documents can be thought of as a two step process In the first step, RGB (Red, Green, Blue) image signals representative of the image are produced by a scanner or a work station (CRT display) Thereafter, a printer receives the RGB image signals, converts them to CMYK printer signals (Cyan, Magenta, Yellow. Key or Black), and generates a hard copy reproduction in accordance therewith. One problem with printers is that their print capabilities and colorants are uniquely defined. As a result, a select RGB image signal, when converted into a CMYK printer signal, may produce differing colors when printed by separate printers. To overcome this problem each printer is provided with a unique LUT (look-up table) for converting RGB image signals into proper CMYK printer signals.

[0003] The printer can print a limited range of colors ("gamut") as faithful reproductions of the intended color. Typically, the colors for images in the form of natural scenes such as are typically derived from a scanned image, as opposed to colors for images generated by the work station, correspond to a limited portion of the printer's available RGB gamut. These colors can be faithfully reproduced into CMYK printer signals by the printer because the LUT has been determined to accomplish a colorimetric match with the intended color of the user. In other words, RGB image signals with natural scene or pure pictorial content are within a "pictorial gamut" of the printer. However, certain RGB image signals, such as those relating to the colors of computer generated graph, are outside of the pictorial gamut of the printer and cannot be reproduced faithfully; typically, computer generated colors are more saturated than pictorial colors. In that computer-generated, saturated colors cannot be faithfully reproduced within the pictorial gamut of the printer, reproduction of such colors requires special translation, via a "graphical gamut," of the RGB image signals into CMYK printer signals before printing. Typical examples of such colors are work station generated pie charts, bar graphs, or text.

[0004] As noted, image signals from a scanner or work station must be translated into printer CMYK format prior to being printed In known prior art systems, the translation is achieved using either a pictorial look-up table corresponding to the pictorial gamut or a graphical look-up table corresponding to the graphical gamut Both gamuts are held in a printer color conversion memory and are used depending on the type of signal to be translated, i.e., whether it is a pictorial image signal or a graphical image signal. Pictorial LUTs translate image signals that are within the pictorial gamut. Graphical LUTs translate saturated graphical RGB image signals into the most fully saturated colors the printer is capable of making Graphical LUTs cannot be used to translate pictorial image signals, and, conversely, pictorial LUTs cannot translate graphical image signals.

[0005] Some RGB image signals may contain both a graphical and a pictorial element Some of these image signals are outside the pictorial gamut of a printer and cannot be translated into CMYK printer signals using merely the pictorial LUT. Likewise, the graphical LUT does not provide proper translation of these RGB images into CMYK printer signals since the graphical LUT is merely directed towards fully saturated image signals. The problem resolved by the subject development comprises how to translate image signals with graphical and pictorial elements when neither LUT can individually adequately accomplish the task.

[0006] One prior art solution to this problem involves compressing or clipping blended image signals outside the range of the pictorial gamut into image signals fully convertible by the pictorial LUT. These prior art techniques of clipping and compressing, however, fail to produce satisfactorily saturated graphic sweeps.

[0007] A color image forming apparatus using color compressed color data is known from US 5 237 409.

[0008] The present invention provides a new and improved technique for printer operation which overcomes the above-referenced problems and others.

[0009] According to one aspect of the present invention, a method is provided for generating a blended printer look-up table which translates image signals having both pictorial and graphical elements into an improved CMYK printer signal.

[0010] According to another aspect of the present invention, a pictorial look-up table for translating the pictorial image signals into printer signal equivalents is generated in accordance with characteristics of a particular printer. Thereafter, a graphical look-up table is generated for translating graphical image signals into printer signal equivalents. Blended pictorial/graphical printer signals are generated by weighting and combining printer signals from both the pictorial and graphical look-up tables. The weighting values are selected to be proportional to the respective pictorial and graphical contents in the corresponding blended image signals. The blended pictorial/graphical printer signals are mapped to the blended pictorial/graphical image signals and stored in a memory for future indexing.

[0011] According to another aspect of the present application, the pictorial and graphical printer signals selected for weighting and adding, are selected from corresponding image signals having the same hue, luminance and chroma. The printer signals are different because one is taken from a pictorial transformation, and the other is taken from a graphical transformation.

[0012] The present invention provides a method according to claim 1. Preferred embodiments are given according to the dependent claims 2 to 6.

[0013] The invention further provides a method for

blending at least two printer look-up tables, according to claim 7 of the appended claims.

[0014] The method preferably further comprises the steps of: generating a third image signal defined in hue, luminance, and saturation space; storing the third image signal in memory mapped to the third printer signal; and wherein the first and second image signals are selected as having a hue and luminance equal to the inputted third image signal.

[0015] The method preferably further comprises the steps of: calculating (1) a difference in saturation ÞX1 between the second and third image signals and (2) a difference in saturation ÞX2 between the first and second image signals; calculating the first and second weighting values as a function of:

$$\frac{\Delta X_1}{\Delta X_1 + \Delta X_2}.$$

[0016] Preferably, the first look-up table defines a pictorial look-up table which relates to a pictorial gamut of the associated printer, and the second look-up table defines a graphical look-up table which relates to a graphical gamut of the associated printer.

[0017] The invention further provides a programmable image processing apparatus according to claim 8.

[0018] The invention further provides an apparatus for blending printer look-up tables, according to claim 9 of the appended claims.

[0019] . Preferably, the blended printer signal corresponds to an image signal having a predetermined relationship to the first image signal and the second image signal.

[0020] Preferably, the predetermined relationship comprises a common hue and luminance and a relative difference in chrominance.

[0021] Preferably, the function comprises a computation of proportional differences in chrominance between the first image signal and the image signal, and between the second image signal and the image signal.

[0022] The signal processor preferably comprises: a means for measuring (1) ÞX1, the proportional chrominance difference between the image signal and the second image signal, and (2) ÞX2, the proportional chrominance difference between the Image signal and the first image signal, a means for multiplying the first and second printer signals from the pictorial and graphical LUTs by f and 1-f respectively, where f is a function of:

$$\frac{\Delta X_1}{\Delta X_1 + \Delta X_2};$$

and an accumulator which adds the multiplied printer signals.

[0023] One advantage of the present invention is that it blends pictorial and graphical look-up tables to form a single printer look-up table used in printing high quality images.

[0024] Another advantage of the present invention is that it provides a single printer look-up table for translating blended image signals having both pictorial and graphical elements

[0025] Yet another advantage of the present invention is that the reproduction of images using a single blended look-up table will exhibit accurate pictorial colors and satisfactorily saturated graphics and sweeps thereto.

[0026] Still further advantages of the present invention will become apparent to those of ordinary skill in the art upon reading and understanding the following detailed description of the preferred embodiments.

[0027] Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 is a schematic diagram of a scan to print system in which the present invention may find advantageous use;

FIGURE 2 is a graphical representation in luminance, hue, saturation space of the RGB space boundary and the pictorial gamut boundary for a typical printer; and

FIGURE 3 is a schematic diagram illustrating table blending implemented in accordance with the present invention.

[0028] With reference to FIGURE 1, a scan to print system in which the present invention may find advantageous use, is shown. The remaining description of the instant invention will be described with reference to image signals generated by a scanner 10 and work station 12, it being understood that the present invention is primarily applicable to reproducing a computer-generated image comprising a blending of elements of both. A typical example would comprise a scanned in photograph being printed with computer generated text or associated diagrams. The text could be printed in a special color such as a fully saturated red or the diagram could include a color sweep from a white to a red within the pictorial gamut up to the fully saturated red.

[0029] FIGURE 1 shows the scanner 10 which generates image signals representing a pictorial or natural scene image of an original document. The image signals are generated by sensing elements which convert light reflected from the original document placed on a copying platen of the scanner. Initially, the image signals are generated in RGB (red-green-blue) format or space.

[0030] Work station 12 receives RGB signals representing a scanned natural scene of the original document. Work station 12 may be used to add text or graphics thereto.Printer 20 reproduces the original document with added text or graphics by adding multiple layers of ink or colorant to a printing medium such as paper. Typically, the printer operates in accordance with a set of color signals defined in CMYK space which is uniquely

defined for the printer by its capabilities and colorants. Thus before the printer can operate to reproduce an original document, the original RGB image signals must be converted into equivalent CMYK printer signals.

[0031] Image signal translator 30 stores printer look-up tables which map image signals defined in RGB space to printer signals defined in CMYK space. Typically, the image signal translator stores the printer look-up tables in ROM or RAM memory with the look-up tables addressable by image signals in RGB format. The look-up table is commonly a three dimension table since color is defined with three variables. In the RGB format, image signal space can be defined as three dimensional with black at the origin of the three dimensional coordinate system 0, 0, 0 and white at the maximum of the three dimensional coordinate system which, for an 8 bit system, would be located at 255, 255, 255. Each of the three axes radiating from the origin point therefore respectively defines red, green, and blue. In the 8 bit system suggested, there will be over 16 million possible colors. Clearly, there are too many values for a one to one mapping of RGB image signals to CMYK printer signals. Therefore, the printer look-up table consists of a set of values which could be said to be intersections for corners of a set of cubes mounted one on top of another. Colors falling within each cube can be interpolated from measured values, through many methods including tn-linear interpolation. tetrahedral interpolation, polynomial interpolation, linear interpolation, and any other interpolation method depending on the desired accuracy of the result.

[0032] Printer 20 has a limited range or space, defined above as the pictorial gamut, of colors that it can produce accurately so that a colonmetric match exists between the scanned in colors or CRT phosphors, and the colors that the printer imparts to the printing medium. Printers may also be requested to print saturated colors outside of this pictorial gamut, such as those produced as computer-generated graphics. These colors are found on the outer boundary of the RGB space of possible colors producible using the assumed RGB primaries, i.e., the graphical gamut. These more saturated colors are clearly outside the pictorial gamut and incapable of being correctly translated by the pictorial look-up table. Accordingly, a second look-up table is required for translating saturated or graphical image signals. This second or graphical look-up table, like the pictorial look-up table, may be stored in ROM or RAM memory within the image signal translator and is addressable by the RGB graphical image signal.

[0033] The pictorial look-up table is generated by first operating the printer with printer signals selected to cause the printer to print samples on a medium The color samples are measured to determine a first colorimetric response to the printer signals. The colorimetric response is used to generate a first mapping of colorimetric signals to printer signals. Thereafter, the first measured colorimetric response may be used to generate an additional mapping of colorimetric values to printer signals. Ultimately, a color conversion mapping is generated as a function of the first or additional mappings and stored in a color conversion memory.

[0034] The graphical LUT is produced by mapping saturated RGB signals (normalized to be between 1 and 0) to C,M,Y,K printer-signals using the relationship C = 1-R, M = 1-G and Y = 1-B, though modifications are sometimes required; for example, when printer blue (100%C & 100%M) is too dark and hue shifted. For less than 100% saturated colors, K is determined and CMY are correspondingly decreased using well-known methods. These modifications are made in such a way that RGB between 0 and 1 map to CMYK between 1 and 0.

[0035] As described above, the prior art was unable to overcome the problem that arises when blended image signals having both pictorial and graphical characteristics are sought to be printed. These blended image signals can be thought of as being between the pictorial gamut and the outer boundary of the RGB space where the saturated colors lie. Neither the pictorial look-up table nor the graphical look-up table provides a suitable translation of blended image signals into CMYK space. While the pictorial look-up table can translate pictorial image signals into printer signals with accurate results, and while the graphical look-up table can translate graphical image signals into printer image signals exhibiting saturated colorant, neither the pictorial nor the graphical look-up tables individually provide satisfactory translation of blended image signals to printer signals.

[0036] The present invention remedies this problem by generating a blended look-up table using a blended look-up table generator 40. The blended look-up table comprises added weighted printer signals from each of the pictorial and graphical look-up tables. The added signals are mapped to a corresponding image signal and stored in memory of the image signal translator. Once generated. the blended look-up table operates to translate image signals which are outside the pictorial gamut but lacking the saturated characteristics associated with the graphical image signals With respect to image signals which are predominantly pictorial in nature, the look-up table produces a printer signal in which the pictorial mapping predominates. With respect to image signals far outside the pictorial gamut of the printer, the blended look-up table produces a printer signal in which the graphics mapping predominates.

[0037] With reference to FIGURE 2, the theory of the present invention will now be explained FIGURE 2 graphs the available RGB space gamut and a typical pictorial gamut in a hue / luminance / saturation space such as LAB space. The outer boundary of the available RGB space, after translation to LAB space, is shown by a dashed line 22. The pictorial gamut, shown as a solid line 24. defines the range of colorimetric matching colors that the printer can faithfully provide The available color space is limited since the initial RGB space is defined in terms of numbers that range from 0 - 255. Since the

pictorial gamut is limited by the range of colors the printer can faithfully reproduce, the pictorial gamut falls inside the graphical gamut. As a result, pictorial look-up tables, when translated into LAB space, map printer signals which fall within the pictorial gamut. The saturated signals of the graphical look-up table lie on the RGB space outer boundary.

[0038] In LAB space, a line extending perpendicular to the L axis defines a range of colors having constant hue and varying saturation. Colors farther away from the L axis, but on a constant hue line. are more saturated. Within the LAB space, B is associated with a range between yellow and blue while A is associated with a range between red and green. If A is positive, the color associated is reddish while a negative A exhibits greenish color. When the B value is positive, the color exhibited is yellow while a negative B value exhibits a bluish color As positions within the LAB space swing toward the negative B axis, the colors turn more bluish. It should be noted, however, that with respect to lines drawn perpendicularly from the L axis, each value along this line exhibits a constant hue.

[0039] As noted above, the printer can reproduce signals contained within the pictorial gamut using a pictorial LUT. Additionally, the printer is capable of handling requests to produce the more saturated colors found on the RGB gamut outer boundary using a graphical LUT Blended pictorial/graphical printer signals can be generated by weighting and thereafter adding printer signals from both the pictorial and graphical look-up tables. The weighting values are selected to be proportional to the pictorial and graphical contents in the corresponding image signals. Colors between the printer gamut and RGB space gamut boundary contain both pictorial and graphical elements. Image signals corresponding to these colors "between" the gamuts, cannot be accurately translated using either the graphical or the pictorial look-up tables. However, the pictorial and graphical look-up tables can be combined in such a way to produce printer signals which generate satisfactory colors associated with signals between the two gamuts.The graph of FIGURE 2 shows a perpendicular line extending from the L axis on which three points P_1, B_1, and G_1 can be found. Since these three points lie on a line extending from the L axis, colors associated with these three points exhibit the same image signal luminance and hue The P_1 point defines a color signal at an intersection of the constant hue line with the pictorial gamut at a point which defines an image signal the color of which is accurately reproducible by the printer. Note that alternatively, a point slightly interior to the pictorial gamut could be used. The G_1 point represents a color signal at an intersection of the constant hue line with the RGB outer boundary at a point which defines an image signal corresponding to a saturated requested color. B_1 represents a desired image signal between the two gamuts such as would be generated from a work station produced color sweep. B_1 is separated from P_1 and G_1 by a difference in chrominance (or saturation) X_2 and X_1 respectively. Given these differences, X_2 and X_1, a blended printer signal comprising a weighted sum of the printer signals associated with the pictorial and graphical mapping can be calculated and mapped to a blended look-up table. The weighting values are calculated as follows.

[0040] The position of B_1 with respect to P_1 and G_1 determines the value of weighting value F. F is equal to 1 when P_1 and B_1 are equal in position, and when B_1 is inside the pictorial gamut. F reduces in magnitude as B_1 moves away from the printer gamut P towards G. F approaches 0 when B_1 and G_1 coincide, which is at the outer boundary of the RGB gamut. Thus, F is a function of :

$$\frac{X_1}{X_1 + X_2}$$

[0041] Given F, the printer signal $LUT_{pictorial}$ (B_1) is multiplied by F and the graphics printer signal $LUT_{graphics}$ (B_1) is multiplied by (1 - F) the results of which are added to form the blended printer signal which is mapped to a corresponding image signal. Given the mapped image signals to blended printer signals, image signals associated with colors close to the printer gamut provide colorants in which the pictorial mapping predominates. For colors far outside the printer gamut, the graphics mapping predominates.

[0042] Note that the above explanation described blending along a line of constant hue and lightness, but other reasonable blending trajectories can be found.

[0043] With reference to FIGURE 3, the blended LUT generator 40 will now be more fully described. Image signal generator 50 generates a set of signals, B_x, which lie on a regular rectangular grid in RGB space. These values will become the indexing nodes of blended LUT 54.

[0044] For each B_x, a corresponding point in LHS (luminance, hue, saturation) space is calculated by the RGB to LHS transformation 70 using a reasonable set of RGB primaries (i.e. CRT phosphors) P_x and G_x are found for each B_x in LHS space and entered in table 52 (though they also may be calculated on the fly) using the construction of FIGURE 2. A line of constant lightness and hue is drawn from the neutral axis through B_x by line generator 72. Pictorial gamut intersector 74 finds P_x the point in LHS space where the line intersects the pictorial gamut, and the graphical gamut intersector 76 finds G_x, the point in LHS space where the line intersects the graphical (RGB) gamut. The weight F_x is calculated from B_x, P_x and G_x by fraction generator 58 using the formulas previously described. $1-F_x$ is calculated from F_x by the subtractor 62, and they are entered in table 56, though they also can be calculated on the fly if desired.

[0045] The graphical CMYK values for B_x are calcu-

lated using graphical LUT 80. the pictorial CMYK values for B_x are calculated using pictorial LUT 82, and they are entered in table 60, though they also can be calculated on the fly if desired. These values are multiplied by the weights in table 56 in multipliers 64 and 66. An accumulator 68 adds the weighted CMYK printer signals the result of which is mapped into the blended look-up table. It is to be understood that initially the pictorial and graphical look-up tables may not have image signal entries with hue and luminance values equal to a selected image signal entry. In this instance, an interpolation can be made with respect to the pictorial and/or graphical image signals to generate the required values.

[0046] Once the blended look-up table has been generated, the mappings are stored in memory of the image signal translator. Thereafter, image signals generated by the scanner are used to index the blended look-up table of the image signal translator to produce blended printer signals which drive printer 20. Images made using the blended look-up table produced reproductions with accurate pictorial colors and graphics sweeps which are more saturated and thus satisfactory.

[0047] It will no doubt be appreciated that the present invention can be accomplished using a software implementation, though a hardware circuit will probably provide optimum speed. It will no doubt be appreciated that the present invention can be implemented through a combination of software and hardware.

Claims

1. A method used in generating a blended look-up table (LUT), which translates an image signal having both pictorial and graphical elements into a blended printer signal, which is part of a gamut of a printer (20), the method comprising the steps of:

   (a) generating a pictorial LUT (82) for translating a pictorial image signal into a pictorial printer signal;

   (b) generating a graphical LUT (80) for translating a graphical image signal into a graphical printer signal;

   (c) generating the image signal;

   (d) selecting a first pictorial printer signal from the pictorial LUT (82) according to the image signal;

   (e) selecting a first graphical printer signal from the graphical LUT (80) according to the image signal;

   (f) generating weighting values for adjusting the first pictorial and graphical printer signals from deriving a first relative distance ΔX_1 between the image signal and a predetermined point on a surface of a pictorial gamut of the image signal, and a second relative distance ΔX_2 between the image signal and a predetermined point on a surface of a graphical gamut of the image signal;

   (g) adjusting the first pictorial and graphical printer signals according to the weighting values;

   (h) deriving a blended printer signal from the adjusted first pictorial and graphical printer signals; and,

   (i) mapping the blended printer signal according to the image signal into the blended LUT.

2. The method of claim 1, wherein the pictorial look-up table (82) translates pictorial image signals into pictorial printer signals for image signals that are within the gamut of the printer.

3. The method of claim 1 or 2, wherein step (h) comprises blending the adjusted first graphical printer signal with the first pictorial printer signal and wherein the image signal is outside the gamut of the printer.

4. The method of claim 1, 2 or 3 wherein the predetermined points on the surface of the pictorial and graphical gamuts of the image signal have a lightness and hue equal to that of the image signal, and the first and second relative distances comprise differences in saturation.

5. The method of claim 4, wherein the weighting values comprise a first weighting value f for association with the first pictorial printer signal and a second weighting value $1-f$ for association with the first graphical printer signal, and wherein the first and second weighting values are generated in proportion to the relative differences in saturation, respectively.

6. The method of claim 5, wherein the first weighting value f is a function of:

$$\frac{\Delta X_1}{\Delta X_1 + \Delta X_2}.$$

7. A method carried out in an appropriately programmed digital computer which includes a memory for storing color printer look-up tables (82, 80) for translating image signals into printer signals for an associated color printer (20), the method being

used in blending at least two printer look-up tables, comprising the steps of:

(s) selecting a first image signal;

(t) reading from memory a first printer signal mapped to the first image signal by a first printer look-up table;

(u) selecting a second image signal;

(v) reading from memory a second printer signal mapped to the second image signal by a second look-up table;

(v') calculating a first and a second the weighing factor being a function of the relative distances between the image signal and a predetermined point on a surface of a pictorial gamut, and between the image signal and a predetermined point on a surface of a graphical gamut;

(w) weighting the first printer signal by multiplying the first printer signal by a first weighting value;

(x) weighting the second printer signal by multiplying the second printer signal by a second weighting value;

(y) generating a third printer signal by adding the weighted first and second printer signals.

8. A programmable image processing apparatus adapted and suitably programmed for carrying out all the method steps of the method of any of the preceding claims, the apparatus including a processor, memory and input/output circuitry.

9. An apparatus for blending printer look-up tables (LUT), said apparatus including:

a first memory which stores a pictorial LUT (82) representative of a pictorial gamut of a printer (20), for converting first image signals into first printer signals wherein a printing of a first printer signal on the printer comprises a faithful color reproduction of a first image signal;

a second memory which stores a graphical LUT (80) representative of a graphical gamut of the printer (20), for converting second image signals into second printer signals wherein a printing of a second printer signal on the printer comprises a saturated color reproduction of a second image signal;

a signal processor in data communication with the first and second memories, for generating a blended printer signal as a function of the first and second printer signals; and,

a third memory which stores the blended printer signal in a blended LUT representative of a complete printable gamut of the printer.

Patentansprüche

1. Verfahren zur Verwendung beim Erzeugen einer vermischten Nachschlagtabelle (LUT), die ein Bildsignal mit Bildelementen und grafischen Elementen in ein vermischtes Druckersignal übersetzt, das Teil einer Farbpalette eines Druckers (20) ist, wobei das Verfahren die Schritte umfasst:

(a) Erzeugen einer Bildelement-LUT (82) zum Übersetzen eines Bildelement-Bildsignals in ein Bildelement-Druckersignal;

(b) Erzeugen einer grafischen LUT (80) zum Übersetzen eines grafischen Bildsignals in ein grafisches Druckersignal;

(c) Erzeugen des Bildsignals;

(d) Auswählen eines ersten Bildelement-Druckersignals aus der Bildelement-LUT (82) entsprechend zu dem Bildsignal;

(e) Auswählen eines ersten grafischen Druckersignals aus der grafischen LUT (80) entsprechend zu dem Bildsignal;

(f) Erzeugen von Gewichtungswerten zum Justieren des ersten Bildelement-Druckersignals und des ersten grafischen Druckersignals durch Herleiten eines ersten relativen Abstandes ΔX_1 zwischen dem Bildsignal und einem vorbestimmten Punkt auf einer Oberfläche einer Bildelement-Farbpalette des Bildsignals, und eines zweiten relativen Abstandes ΔX_2 zwischen dem Bildsignal und einem vorbestimmten Punkt auf einer Oberfläche einer grafischen Farbpalette des Bildsignals;

(g) Justieren der ersten Bildelement- und grafischen Druckersignale entsprechend zu den Gewichtungswerten;

(h) Ableiten eines vermischten Druckersignals aus den justierten ersten Bildelement- und grafischen Druckersignalen und

(i) Abbilden des vermischten Druckersignals entsprechend zu dem Bildsignal in eine ver-

mischte LUT.

2. Das Verfahren nach Anspruch 1, wobei die Bildelement-Nachschlagtabelle (82) Bildelement-Bildsignale in Bildelement-Druckersignale für solche Bildsignale übersetzt, die innerhalb der Farbpalette des Druckers liegen.

3. Das Verfahren nach Anspruch 1 oder 2, wobei der Schritt (h) umfasst: Vermischen des justierten ersten grafischen Druckersignals mit dem ersten Bildelement-Druckersignal, und wobei das Bildsignal außerhalb der Farbpalette des Druckers liegt.

4. Das Verfahren nach Anspruch 1, 2 oder 3, wobei die vorbestimmten Punkte auf der Oberfläche der Bildelements-Farbpalette und der grafischen Farbpalette des Bildsignals eine Helligkeit und eine Farbtönung aufweisen, die gleich ist zu jener des Bildsignals, und wobei die ersten und zweiten relativen Abstände Unterschiede in der Sättigung aufweisen.

5. Das Verfahren nach Anspruch 4, wobei die Gewichtungswerte einen ersten Gewichtungswert f zur Verknüpfung mit dem ersten Bildelement-Druckersignal und einen zweiten Gewichtungswert 1-f zur Verknüpfung mit dem ersten grafischen Druckersignal umfassen, und wobei die ersten und zweiten Gewichtungswerte jeweils im Verhältnis zu den relativen Differenzen in der Sättigung erzeugt werden.

6. Das Verfahren nach Anspruch 5, wobei der erste Gewichtungswert f eine Funktion ist von

$$\frac{\Delta X_1}{\Delta X_1 + \Delta X_2}.$$

7. Verfahren, das in einem geeignet programmierten Digitalrechner ausführbar ist, der einen Speicher zum Speichern von Farbdrucker-Nachschlagtabellen (82,80) aufweist, um Bildsignale in Druckersignale für einen entsprechenden Farbdrucker (20) zu übersetzen, wobei das zur Vermischung zumindest zweier Drucker-Nachschlagtabellen verwendete Verfahren die Schritte umfasst:

(s) Auswählen eines ersten Bildsignals;

(t) Auslesen aus dem Speicher eines ersten Druckersignals, das mittels einer ersten Drucker-Nachschlagtabelle auf das erste Bildsignal abgebildet ist;

(u) Auswählen eines zweiten Bildsignals;

(v) Auslesen aus dem Speicher eines zweiten Druckersignals, das mittels einer zweiten Nachschlagtabelle auf das zweite Bildsignal abgebildet ist;

(v') Berechnen eines ersten und zweiten Gewichtungsfaktors, die eine Funktion der relativen Abstände zwischen dem Bildsignal und einem vorbestimmten Punkt auf einer Oberfläche einer Bildelement-Farbpalette und zwischen dem Bildsignal und einem vorbestimmten Punkt auf einer Oberfläche einer grafischen Farbpalette sind;

(w) Gewichten des ersten Druckersignals durch Multiplizieren des ersten Druckersignals mit dem ersten Gewichtungswert;

(x) Gewichten des zweiten Druckersignals durch Multiplizieren des zweiten Druckersignals mit dem zweiten Gewichtungswert;

(y) Erzeugen eines dritten Druckersignals durch Addieren der gewichteten ersten und zweiten Druckersignale.

8. Programmierbare Bildverarbeitungsvorrichtung, die ausgebildet und geeignet programmiert ist, um alle Verfahrensschritte des Verfahrens eines der vorhergehenden Ansprüche auszuführen, wobei die Vorrichtung einen Prozessor, einen Speicher und eine Eingabe/Ausgabeschaltung aufweist.

9. Vorrichtung zum Vermischen von Drucker-Nachschlagtabellen (LUT), wobei die Vorrichtung umfasst:

einen ersten Speicher, der eine Bildelement-LUT (82) speichert, die eine Bildelement-Farbpalette eines Druckers (20) repräsentiert, um erste Bildsignale in erste Druckersignale zu konvertieren, wobei ein Druck eines ersten Druckersignals auf dem Drucker eine farbgetreue Farbreproduktion eines ersten Bildsignals aufweist;

einen zweiten Speicher, der eine grafische LUT (80) speichert, die eine grafische Farbpalette des Druckers (20) repräsentiert, um zweite Bildsignale in zweite Drukkersignale zu konvertieren, wobei ein Druck eines zweiten Druckersignals auf dem Drukker eine gesättigte Farbreproduktion eines zweiten Bildsignals aufweist;

einen Signalprozessor, der in Datenkommunikation mit den ersten und zweiten Speichern ist, um ein vermischtes Druckersignal als eine

Funktion der ersten und zweiten Druckersignale zu erzeugen; und

einen dritten Speicher, der das vermischte Druckersignal in einer vermischten LUT speichert, die eine vollständig druckbare Farbpalette des Druckers repräsentiert.

Revendications

1. Procédé utilisé au cours de la génération d'une table de consultation mélangée (LUT), qui traduit un signal d'image comportant des éléments à la fois illustratifs et graphiques en un signal pour imprimante mélangé, qui fait partie d'un espace de rendu des couleurs d'une imprimante (20), le procédé comprenant les étapes consistant à :

   (a) générer une table LUT pour illustration (82) destinée à traduire un signal illustratif d'image en un signal illustratif pour imprimante,
   (b) générer une table LUT graphique (80) destinée à traduire un signal graphique d'image en un signal graphique pour imprimante,
   (c) générer le signal d'image,
   (d) sélectionner un premier signal illustratif pour imprimante à partir de la table LUT pour illustration (82) conformément au signal d'image,
   (e) sélectionner un premier signal graphique pour imprimante à partir de la table LUT graphique (80) conformément au signal d'image,
   (f) générer des valeurs de pondération destinées à ajuster les premiers signaux illustratifs et graphiques à partir d'une dérivation d'une première distance relative ΔX_1 entre le signal d'image et un point prédéterminé sur une surface d'un espace de rendu des couleurs d'illustrations du signal d'image, et une seconde distance relative ΔX_2 entre le signal d'image et un point prédéterminé sur une surface de l'espace de rendu des couleurs d'illustrations graphique du signal d'image,
   (g) ajuster les premiers signaux illustratifs et graphiques pour imprimante conformément aux valeurs de pondération,
   (h) obtenir un signal mélangé pour imprimante à partir des premiers signaux illustratifs et graphiques pour imprimante ajustés, et
   (i) mapper le signal mélangé pour imprimante conformément au signal d'image dans la table LUT mélangée.

2. Procédé selon la revendication 1, dans lequel la table de consultation pour illustration (82) traduit des signaux illustratifs d'image en des signaux illustratifs pour imprimante destinés à des signaux d'image qui se situent à l'intérieur de l'espace de rendu des couleurs de l'imprimante.

3. Procédé selon la revendication 1 ou 2, dans lequel l'étape (h) comprend du premier signal graphique ajusté pour imprimante avec le premier signal illustratif pour imprimante et dans lequel le signal d'image se situe à l'extérieur de l'espace de rendu des couleurs de l'imprimante.

4. Procédé selon la revendication 1, 2 ou 3, dans lequel les points prédéterminés sur la surface des espaces de rendu des couleurs d'images et graphiques du signal d'image présentent une luminance et une teinte égales à celles du signal d'image, et les première et seconde distances relatives comprennent des différences de saturation.

5. Procédé selon la revendication 4, dans lequel les valeurs de pondération comprennent une première valeur de pondération *f* destinée à une association avec le premier signal illustratif pour imprimante et une seconde valeur de pondération 1 - *f* destinée à une association avec le premier signal graphique pour imprimante, et dans lequel les première et seconde valeurs de pondération sont générées proportionnellement aux différences relatives de saturation, respectivement.

6. Procédé selon la revendication 5, dans lequel la première valeur de pondération *f* est fonction de :

$$\frac{\Delta X_1}{\Delta X_1 + \Delta X_2}$$

7. Procédé exécuté dans un ordinateur numérique programmé de façon appropriée qui comprend une mémoire destinée à stocker des tables de consultation d'imprimante en couleurs (82, 80) en vue de traduire des signaux d'image en des signaux pour imprimante pour une imprimante en couleurs associée (20), le procédé étant utilisé dans le mélange d'au moins deux tables de consultation d'imprimante, comprenant les étapes consistant à :

   (s) sélectionner un premier signal d'image,
   (t) lire à partir de la mémoire un premier signal pour imprimante mappé sur le premier signal d'image par une première table de consultation d'imprimante,
   (u) sélectionner un second signal d'image,
   (v) lire à partir de la mémoire un second pour imprimante mappé sur le second signal d'image par une seconde table de consultation,
   (v') calculer un premier et un second signal, le facteur de pondération étant fonction des distances relatives entre le signal d'image et un

point prédéterminé sur une surface de l'espace de rendu des couleurs d'illustrations, et entre le signal d'image et un point prédéterminé sur une surface de l'espace de rendu des couleurs d'illustrations graphique,
(w) pondérer le premier signal pour imprimante en multipliant le premier signal pour imprimante par une première valeur de pondération,
(x) pondérer le premier signal pour imprimante en multipliant le second signal pour imprimante par une seconde valeur de pondération,
(y) générer un troisième signal pour imprimante en ajoutant les premier et second signaux pour imprimante pondérés.

8. Dispositif de traitement d'image programmable conçu et programmé de façon appropriée pour exécuter toutes les étapes de procédé du procédé de l'une quelconque des revendications précédentes, le dispositif comprenant un processeur, une mémoire et des circuits d'entrée/sortie.

9. Dispositif destiné à mélanger des tables de consultation d'imprimante (LUT), ledit dispositif comprenant :

une première mémoire qui stocke une table LUT pour illustration (82) représentative d'un espace de rendu des couleurs d'illustrations d'une imprimante (20), en vue de convertir des premiers signaux d'image en des premiers signaux pour imprimante, dans lequel une impression d'un premier signal pour imprimante sur l'imprimante comprend une reproduction fidèle de la couleur d'un premier signal d'image,
une seconde mémoire qui stocke une table de consultation graphique (80) représentative d'un espace de rendu des couleurs graphique de l'imprimante (20), en vue de convertir des seconds signaux d'image en des seconds signaux pour imprimante, dans lequel une impression d'un second signal pour imprimante sur l'imprimante comprend une reproduction saturée de la couleur d'un second signal d'image,
un processeur de signal en communication de données avec les première et seconde mémoires, destiné à générer un signal mélangé pour imprimante en fonction des premier et second signaux pour imprimante, et
une troisième mémoire qui stocke le signal mélangé pour imprimante dans une table LUT mélangée représentative d'un espace de rendu des couleurs complet pouvant être imprimé de l'imprimante.

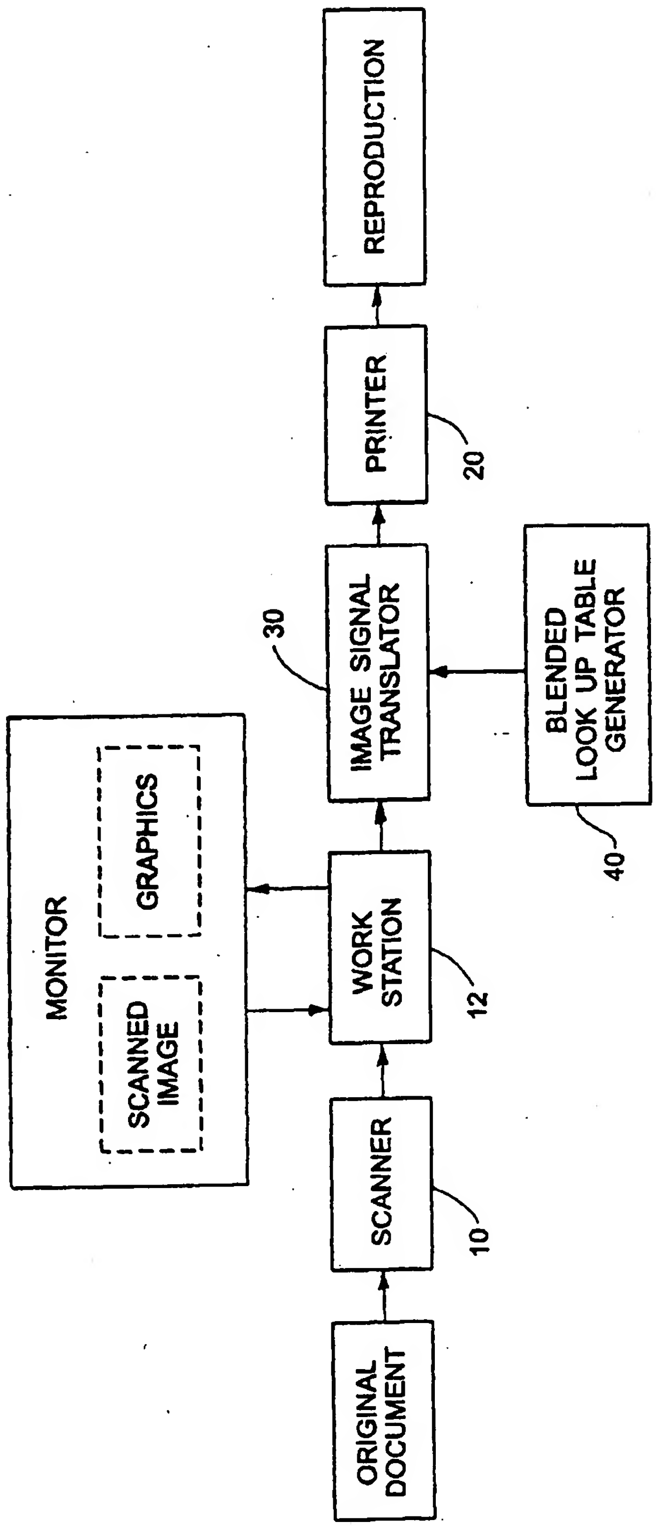
ORIGINAL DOCUMENT
SCANNER
10
MONITOR
SCANNED IMAGE
GRAPHICS
WORK STATION
12
IMAGE SIGNAL TRANSLATOR
30
BLENDED LOOK UP TABLE GENERATOR
40
PRINTER
20
REPRODUCTION

FIG. 1

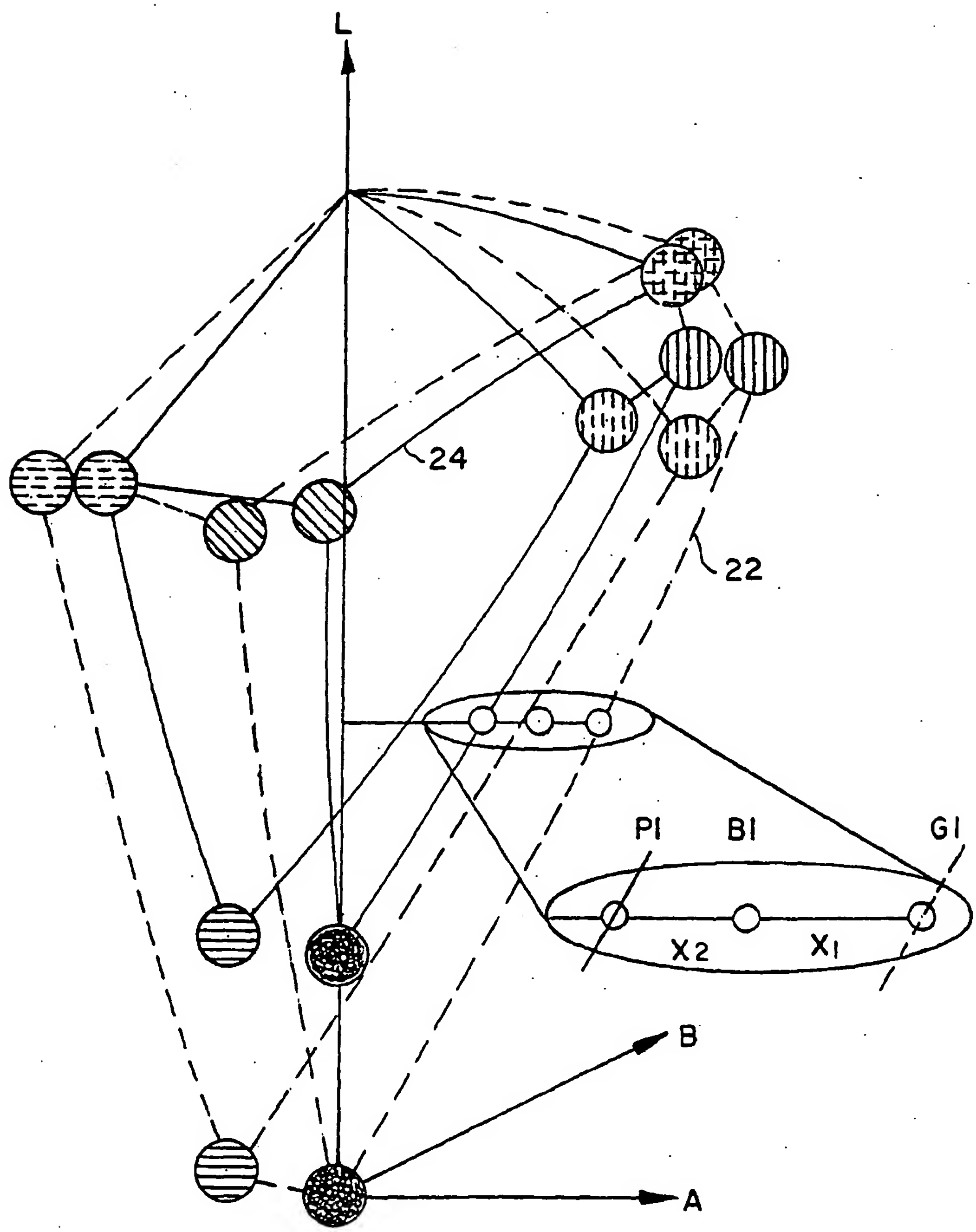

FIG. 2

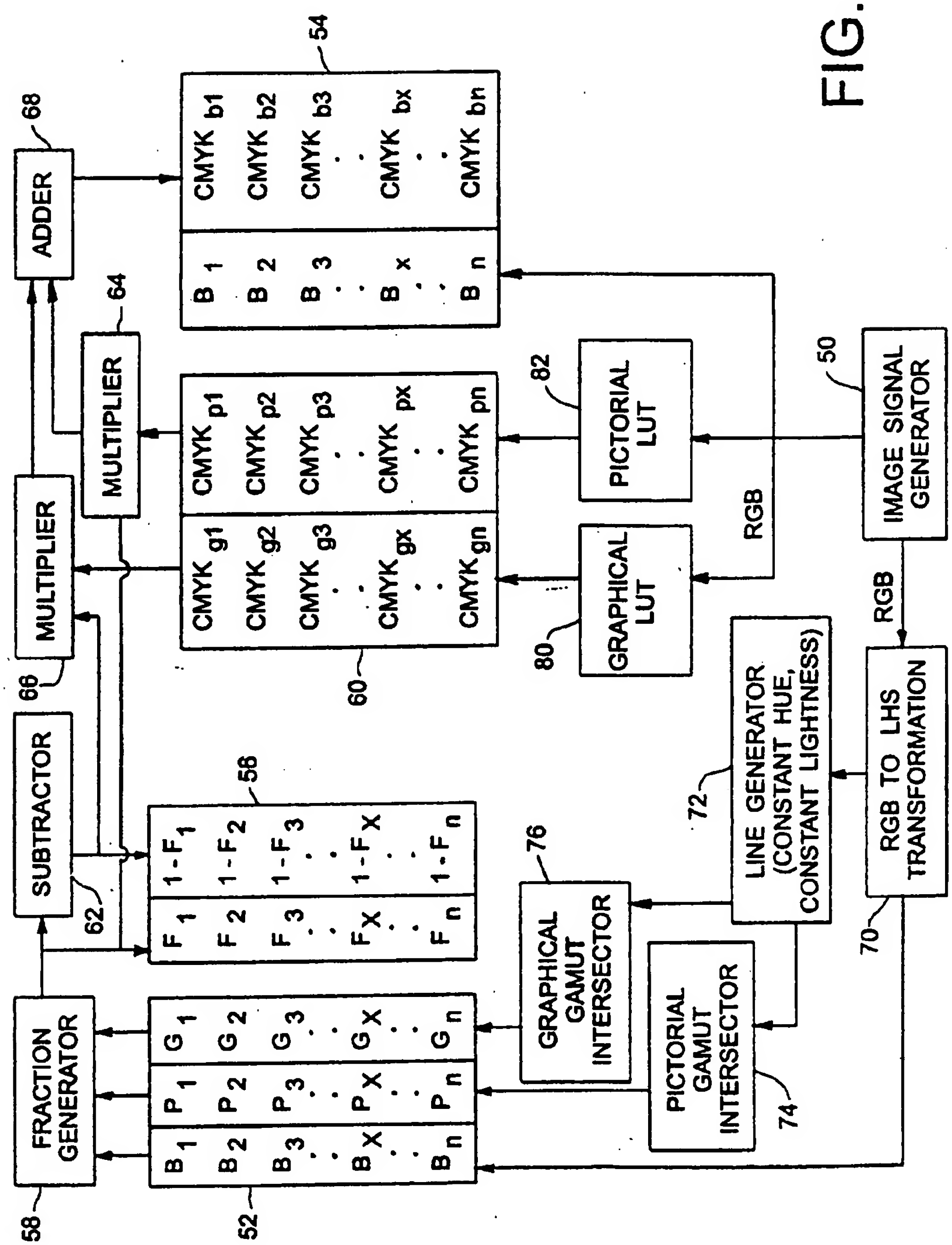
ADDER
68
MULTIPLIER
64
MULTIPLIER
66
SUBTRACTOR
62
FRACTION GENERATOR
58
54
CMYK b1
CMYK b2
CMYK b3
CMYK bx
CMYK bn
B 1
B 2
B 3
B x
B n
CMYK p1
CMYK p2
CMYK p3
CMYK px
CMYK pn
CMYK g1
CMYK g2
CMYK g3
CMYK gx
CMYK gn
60
PICTORIAL LUT
82
GRAPHICAL LUT
80
RGB
IMAGE SIGNAL GENERATOR
50
RGB
RGB TO LHS TRANSFORMATION
70
LINE GENERATOR (CONSTANT HUE, CONSTANT LIGHTNESS)
72
58
F 1
F 2
F 3
F X
F n
1 - F 1
1 - F 2
1 - F 3
1 - F X
1 - F n
GRAPHICAL GAMUT INTERSECTOR
76
PICTORIAL GAMUT INTERSECTOR
74
G 1
G 2
G 3
G X
G n
P 1
P 2
P 3
P X
P n
B 1
B 2
B 3
B X
B n
52

FIG. 3